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Letter to the Editor

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Intraoperative detection of bile leakage using hydrogen peroxide during laparoscopic cholecystectomy

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Dear Editor,

Bile leakage remains a significant concern for patients undergoing laparoscopic cholecystectomy (LC). Unrecognized segmental/sectoral duct injury (SDI) leads to a complex postoperative course after LC, often complicated by biliary peritonitis, sepsis, or secondary vascular complications. There are two types of SDI, based on the size and drainage territory of the injured duct: (type 1) injury to the right anterior/posterior sectoral duct or any other segmental bile duct draining at least one Couinaud segment and (type 2) injury to a minor biliary radical in the gallbladder fossa, i.e., injury to the subvesical biliary duct or the duct of Luschka, which is usually less than 1 mm in diameter.[1] Intraoperative cholangiography through the injured duct was performed to delineate the corresponding liver segments in patients with type 1 SDI. When recognized intraoperatively, a biliary-enteric anastomosis in a Roux-en-Y hepaticojejunostomy or hepatojejunostomy is required for a transected major sectoral duct or segmental bile duct owing to large amounts of bile production. In patients with type 2 SDI, oversewing with 5-0 polypropylene or polydioxanone sutures is usually sufficient to control leaks.[2,3]

However, type 2 SDI is usually difficult to detect by intraoperative cholangiography or postoperative CT, MRCP, or endoscopic retrograde cholangio pancreatography (ERCP) because the injured duct drains only a small portion of the liver parenchyma.[1,4] Therefore, when a suspicious bile leak occurs in the gallbladder fossa intraoperatively, additional diagnostic procedures are required to identify the leak site precisely.

Although none have gained widespread acceptance, several tests for bile leakage have recently been proposed to detect minor bile leak sites from the cut surface of the liver after hepatic resection. The conventional intraoperative bile leakage test, which involves injecting normal saline through the cystic duct, is a low-cost and easily reproducible method; however, this technique is ineffective for detecting minor bile leakage from the transected liver surface due to the transparent nature of the solution.[5] Additionally, injection of various dye solutions, including methylene blue, is advised; however, this method entails dyeing the field of interest and masking additional bile leak sites.[6] The white test, which involves injecting a fat emulsion solution through the cystic duct, has also been recommended.[5] However, fat emboli, immunosuppressive effects, and fungal infections are among the drawbacks of the white test.[7] Furthermore, because they are performed on the cystic duct, these techniques are both time-consuming and challenging to adapt to laparoscopic cholecystectomy. A recent study showed that intraoperative fluorescent cholangiography using indocyanine green could detect bile leakage from subvesical aberrant bile duct injuries during laparoscopic cholecystectomy.[8] However, only some hospitals have special equipment and expertise to perform bile leakage tests using fluorescent cholangiography.

The topical application of 1.5% diluted hydrogen peroxide (H_2O_2) during surgery has recently raised awareness about potential bile injuries that could be overlooked intraoperatively.[7] Bile leakage is easily detected using 1.5% diluted hydrogen peroxide, which produces thick white foam (Figure). Moreover, it is non-invasive, easy to apply, harmless to tissues, and easily removed without leaving behind false tissue coloration. It also has the advantage of applying to laparoscopic surgeries. Currently, we effectively use H_2O_2 for the detection of bile leakage not only during laparoscopic cholecystectomy but also during major liver resections and liver hydatid surgery.

In conclusion, we recommend the topical application of 1.5% diluted hydrogen peroxide to investigate bile leakage. This is a simple, non-invasive, less time-consuming, repeatable, and readily available technique with no adverse effects.

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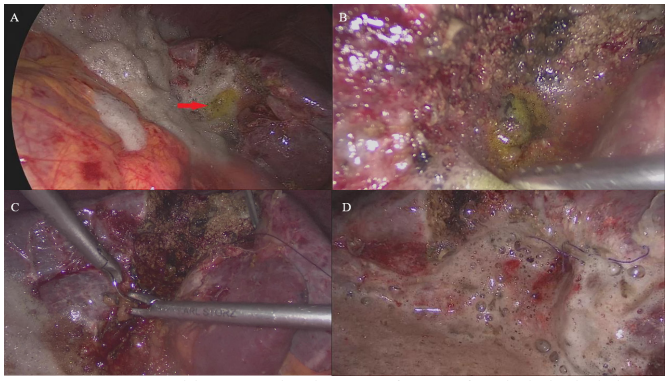

Figure. A 53-year-old man with a history of ERCP for choledocholithiasis underwent LC. Because severe inflammation stiffened the gallbladder wall, the dissection direction was slightly shifted towards the liver parenchyma adjacent to the body of the gallbladder

After the gallbladder was removed, saline-diluted hydrogen peroxide was applied to the transected surface of the liver to detect any leakage. (A) Following this application, yellow bile became visible on the cut surface of the gallbladder fossa. (B) After the site of bile leakage was detected, it was primarily closed with polydioxanone sutures. (C) No bile leakage was observed in the repeated test using diluted hydrogen peroxide (D); **ERCP:** Endoscopic retrograde cholangio pancreatography, **LC:** Laparoscopic cholecystectomy

Keywords: Bile leakage, hydrogen peroxide, laparoscopic cholecystectomy

ETHICAL DECLARATIONS

Informed Consent
The patient signed the free and informed consent form.

Referee Evaluation Process
Externally peer-reviewed.

Conflict of Interest Statement
The authors have no conflicts of interest to declare.

Financial Disclosure
A conflict of interest has not been declared by the author.

Author Contributions
All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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